

Staff Paper 187

A REVIEW OF RESEARCH:
ECONOMIES OF SIZE AND IMPACTS OF
DECLINING ENROLLMENT ON SCHOOL COSTS *

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DISCUSSION OUTLINE:

A. Differences in Size Economies / Declining Enrollment Studies.

B. Declining Enrollment Findings:

- Consequences depend upon distribution of decline.
- Total Expenditures per pupil rise.
- Costs per pupil rise more in short run, less in long run.
- Per pupil instruction, plant operation, maintenance and administration cost categories all rise.
- Younger, less experienced staff adjust out.
- Average salaries rise as experienced staff retained.
- Instructional costs adjusts more than administration costs.

C. Economies of Size Findings:

- 33 out of 34 studies find economies of size.
 - Most found U-shaped economies of size.
 - Size economies are related to sparsity.
 - Size economies vary for elementary and high schools.
 - Iowa course offerings, pupil/teacher ratios vary by size.
 - More vocational/elective subjects added with size.
 - 1000-2499 pupils are cheapest group in Iowa.
 - Projected pupil declines affect large and small schools.
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A REVIEW OF RESEARCH: ECONOMIES OF SIZE AND IMPACTS
OF DECLINING ENROLLMENT ON SCHOOL COSTS

Over the last decade, lower birth rates and population migration have caused declining school enrollments, not only in Iowa, but in many parts of the country. For this reason, many state and local leaders, school officials and students of school finance have studied these trends. Such studies have focused on effects of declining enrollment on school management and expenditures and economies of size in school organization. Studies of each type are reviewed in turn.

At first glance it may seem that declining enrollment studies and economies of size studies deal with the same thing. Both types look at the effect of differing numbers of students on the cost of education. However, the methodology and interpretation of the results are not the same.

The declining enrollment studies generally use time series data. This means that these studies use observations on the same set of schools or districts for a number of successive years. These studies then pick up the effects of decline in enrollment over time and to some extent the effects of changes in policies and economic conditions.

On the other hand, the economies of size studies generally use cross-sectional data. This means that the studies use data for a single time period and compares the data for many schools or school districts. These schools or districts are subject to the same state aid formula, the same set of state and federal programs, and the same general economic conditions. Some of these studies attempt to make adjustments for level of service,

program differences, price of inputs, student performance and education demand attributes and socio-economic factors in an attempt to estimate variations in the cost of education attributable to size of district or school.

EFFECTS OF DECLINING ENROLLMENT

Total expenditures per pupil for education have unambiguously increased during the last 15 years, regardless of whether the schools had increasing or decreasing enrollments. These cost increases are associated with the rising price of inputs for education (teacher pay, transportation costs, energy costs, etc.) and an increasing number of constraints imposed on school districts by the state and federal government (minimum course offerings, minimum teacher pay, provision of special programs, etc.) The declining enrollment studies attempt to adjust for these cost changes and sort out the "pure" effects attributable to declining enrollment. In addition, other declining enrollment studies focus on the more specific effects of declining enrollment on specific budget categories, course offerings, special programs and services provided, hiring and salary practices, and pupil/teacher ratios.

A comprehensive collection of studies on the effects of enrollment decline was edited for the National Institute of Education in 1978 (Abramowitz and Rosenfeld). While the age of this effort renders the quantitative parts of the study obsolete, the qualitative statements are still quite relevant today.

One study in this collection (Wilken and Callahan), demonstrates that the distribution of the enrollment decline can

alter the consequences to be expected. In particular, if the enrollment decline is concentrated in particular schools or in particular grades it will be relatively easy for the school district to adjust. On the other hand, if the decline is spread out across grades and across all attendance centers in the district, it may be relatively harder for the district to adjust.

Another study in this collection (Odden and Vincent), found that the education costs per pupil rose when enrollments declined. This study was conducted in four states: Michigan, Missouri, South Dakota, and Washington. This study also found that the fiscal strain is especially acute in the short-run and the authors cited three reasons for this:

- i) Personnel contracts are signed before the actual student count for the coming year is known. This leads to a lag of at least one year in staff reductions.
- ii) Seniority provisions generally lead to the layoff of the least experienced and least costly teachers.
- iii) Until the decline is severe enough to close schools the districts can't get out from under the fixed expenditures on building maintenance and operations.

These results have stood the test of time for most of the more recent and similar studies have verified these results or have built on them (Anderson and Mark; Hentschke and Yagielski).

A study of Indiana schools in the late-1970s (Debertin) categorized districts by magnitude of enrollment decline and found similar results. In this study, as the magnitude of enrollment decline increased, total per pupil expenditures increased and each of several per pupil expenditure categories increased (instruction, plant operation, and maintenance).

In addition, Debertin found that pupil/teacher ratios fell

and average salary levels increased when enrollment declined. While some staff reductions were made in response to declining enrollment, the staff reductions were not proportional to the enrollment declines. Average salaries rose because the staff who were let go, tended to be younger teachers with less training, experience, and lower salaries.

In a more recent study (Cavin, Murnane and Brown), differences between the short run and long run effects were analyzed. This 1985 Michigan study found that a 20 percent decline in enrollment over two years would result in a 19 percent increase in per pupil expenditures in the short run and a 10 percent increase in the long run. The reason that the long run increase in expenditure is smaller than the short run increase is due to the ability of the school districts to adjust to the decline more fully over a longer period of time.

It is important to note that declining enrollment leads to higher expenditures per pupil in long run, even with the added ability of a school district to make adjustments. This study also found that small school districts were less able to adjust to enrollment declines. Small schools have less internal programming and staffing flexibility compared to others.

Cavin, Murnane and Brown also discuss the effect of enrollment decline on professional staff levels. They found that pupil/teacher staffing levels fell abruptly in the first year of an pupil decline. This is due to little or no immediate adjustment in staff to the enrollment decline. In the long run, a mixed pattern of adjustment in the staff levels occurs.

It is interesting to note the differences in long run

adjustment by staff type. This study found that a 20 percent decrease in enrollment led to only a 4 percent decline in pupil/teacher ratio in the long run. This implies that the size of the teaching staff was reduced by 16 percent. On the other hand, the reductions in administrative staff were much smaller. This result has been supported by other researchers.

Anderson and Mark (1985) observed similar trends in personnel in their study of Missouri school systems. This paper offered some of the more common reasons cited in the literature for these trends. The reason pupil/teacher ratios have fallen over the long run is due, in part, to the increased provision of specialized services by school districts. The disproportionate increase in administrative staff per pupil is attributed, in part, to the increasing complexity of running a school system, mandatory information gathering and reporting requirements by higher levels of government. Because of this, enrollment declines do not result in any less paperwork and consequently no fewer administrators, unless sharing or consolidation occurs.

One last area of focus in some enrollment decline studies has been the provision of various services by school districts. One 1985 study (Hartman and Rivenburg) for school districts in Oregon found that in the area of instructional services, "special" services were the first to go when enrollment declined. This result was counter to expectations in light of the alleged increases in special service requirements by state and federal governments. However, the study did not examine the differential impacts on various types of special services (discretionary versus mandated), thus perhaps further analysis is warranted.

In the area of support services, this study found no change in the distribution of expenditures between the various types. And finally, in the area of administrative services, the study found that the budget resources of school business managers tend to decline relative to the budget resources of superintendents and school principals, as enrollments declined.

SCHOOL ECONOMIES OF SIZE STUDIES

An extensive review of the size economies studies for schools was published in 1981 (Fox). This review provided a summary of the theory and methods used in these studies, plus a comprehensive summary of the results. All but one of the 34 studies reviewed concluded that economies of size existed within the relevant range of enrollment levels.

In addition, most studies found that "per pupil school costs appear to be characterized by a U-shaped average cost curve." This means, for a given level of educational quality, size economies exist for a range of enrollment. However, if enrollment exceeds a certain level, then average costs begin to rise for the larger schools.

This does not imply that all studies are in agreement. There is much debate as to the degree that economies exist. The differences arise due to differences in size and type of schools and cost measures used. The studies that find lower thresholds for economies generally have been in states where geographic sparsity dominates the observations. They generally find minimum school costs at school sizes of 700 pupils or less. Studies in states where urban schools dominate the observations find larger threshold levels of 2,000 or more.

A 1986 study (Riew) estimates size economies separately for secondary and elementary schools in Maryland. This study found that size economies existed for both secondary and elementary schools but that the extent of the economies differed between them. In particular, he found that the economies were for the most part used up at enrollment levels of 500 for elementary schools and at enrollment levels of 900 for secondary schools. He also found that the greatest cost savings from size economies occurred in the 600-800 pupil level for secondary schools and in the 200-300 pupil level for elementary schools.

These ranges are similar to Iowa State University Extension school sharing materials used in school district restructuring discussions (Appendix A). These materials illustrate the relationship of size economies to the organizational options of high schools, elementary schools, and the desired educational opportunity for the children.

The materials also illustrate the relationships between school district size and high school subject matter offerings. Iowa districts with 300 total pupils tend to have 100 pupils in grades 9 through 12 and offer approximately 40 high school course units. Those districts with 600 total pupils, have 200 pupils in grades 9 through 12 and offer 50 high school course units. Those districts with 900 total pupils have 300 in grades 9 through 12 and offer 60 high school course units.

In addition, these materials include the results of an analysis which shows that the differences in course units by school size are not uniformly distributed between academic subjects (english, math and science) and vocational electives

(business, industrial arts, home economics, agriculture, music, art, and foreign languages.) In comparing districts with 50 and 60 course units to districts with 10 fewer course units, the districts with larger offerings tend to have two additional units of academic subjects and eight more vocational electives. This implies that as school size grows, students who are likely to enter the job market immediately after high school would benefit most from expansion in the high school course offerings.

Raw aggregate data from another Iowa study in 1986 (Edelman and Otto) and from the Iowa Department of Public Instruction were analyzed for a rough estimate of size economies. This analysis showed a U-shaped curve in terms of economies of size (Table 1). This study shows that school districts with 1,000 to 2,499 have the lowest 1984-85 expenditures per pupil in Iowa.

Iowa districts with less than 250 pupils, account for 11.9 percent of the districts, 2.1 percent of the students and spent \$576 per pupil more than the districts with 1,000 to 2,499 pupils. On the other hand, districts with more than 7,500 pupils account for 1.8 percent of the districts, 25.3 percent of the pupils and spent \$168 more per pupil than the least cost group.

This study also provides an understanding of school finance indicators by valuation groups (Table 2), per pupil expenditure groups (Table 3), and projected enrollment groups (Table 4.) There are apparent size relationships across per pupil valuation groups and expenditure groups.

However, there are few relationships across projected enrollment groups. The projected enrollment results are interesting in that both large and small school districts seem to

Table 1. Iowa School District Indicators by Enrollment Group, 1984-85.

Enrollment Group	% of Dists.	% of Pupils	% Enr Chg 1990-91	Exp. Per Pupil *	Val Per Pupil	Course Units	P/T Ratio
< 250	11.9	2.1	-8.6	3439	274049	39.6	10.4
250 - 399	19.6	5.6	-5.1	3061	220252	43.5	13.2
400 - 599	22.2	9.8	-5.8	2930	179450	48.1	14.4
600 - 999	22.6	15.0	-3.5	2903	161228	52.6	15.5
1000-2499	16.4	22.6	-4.9	2863	139512	63.6	16.7
2500-7499	5.5	19.6	-6.9	2893	115853	89.1	18.8
7500 up	1.8	25.3	-2.7	3031	109982	150.1	19.4

* Includes transportation costs, therefore not a "true economies of size" analysis for operations inside the school buildings.

Source: Compiled from Iowa Department of Public Instruction data as reported by Edelman and Otto in Iowa Tax Facts for Financing State and Local Government, CES Pm 1281, Iowa State University, Nov 1986.

Table 2. Iowa School District Indicators by Valuation Group, 1984-85.

Val Per Pupil *	% of Dists.	% of Pupils	Average % Enr Chg Enroll.	% Enr Chg 1990-91	Exp Per Pupil **	Course Units	P/T Ratio
<100000	7.3	15.6	2356	-5.6	2843	70.6	17.1
100000-199999	60.9	73.1	1326	-4.3	2907	56.3	15.4
200000-299999	23.1	9.2	437	-5.8	3100	46.2	13.3
300000-399999	6.4	1.6	280	-6.4	3412	41.9	11.1
400000-499999	1.8	.4	253	-11.6	3818	45.5	10.2
500000 up	.5	.1	183	-9.0	4038	38.0	8.9

* No adjustments are made for state revenues used for property tax credits and rollbacks.

** Includes transportation costs, therefore not a "true economies of size" analysis of operations inside the school buildings.

Source: Compiled from Iowa Department of Public Instruction data as reported by Edelman and Otto in Iowa Tax Facts for Financing State and Local Government, CES Pm 1281, Iowa State University, Nov 1986.

Table 3. Iowa School District Indicators by Expenditure Group, 1984-85.

Expend./ Pupil *	% of Dists.	% of Pupils	Average % Enr Chg 1990-91	Val Per Pupil	Course Units	P/T Ratio
< 2500	.5	.4	889	8.4	161147	60.3 17.0
2500-2999	57.4	62.9	1210	-4.4	154031	55.4 15.5
3000-3499	35.5	35.4	1101	-4.9	202153	53.4 14.0
3500-3999	5.5	1.1	228	-11.2	340311	40.9 9.9
4000- up	1.1	.2	182	-33.2	368185	42.5 10.6

* Includes transportation costs, therefore not a "true economies of size" analysis of operations inside the school buildings.

Source: Compiled from Iowa Department of Public Instruction data as reported by Edelman and Otto in Iowa Tax Facts for Financing State and Local Government, CES Pm 1281, Iowa State University, Nov 1986.

Table 4. Iowa School District Indicators by Projected Enrollment Group, 1984-85 to 1990-91.

Proj Enroll Group	% of Dists.	% of Pupils	Average % Enroll.	Exp Per Pupil *	Val per Pupil	Course Units	P/T Ratio
> 10% decr.	28.4	21.5	837	3093	198201	50.5 13.7	
5-10% decr.	23.1	26.0	1241	3032	186907	54.0 14.6	
0-5% decr.	24.5	30.3	1366	2924	168456	57.8 15.5	
0-5% incr.	12.8	8.2	704	2937	179580	52.0 14.9	
5-10% incr.	6.4	11.1	2023	2939	173100	59.2 15.5	
> 10% incr.	4.8	2.3	522	2955	187783	49.3 14.4	

* Note that 24 percent of the small districts have projected enrollment increases and so do 24 percent of the large districts. On the other hand, 35 percent of the small districts have projected enrollment declines greater than negative 10 percent, while only 24 percent of the large districts have enrollment declines of that percentage magnitude. In terms of absolute numbers, however, the large districts are projected to loose more pupils.

** Includes transportation costs, therefore not a "true economies of size" analysis of operations inside the school buildings.

Source: Compiled from Iowa Department of Public Instruction data as reported by Edelman and Otto in Iowa Tax Facts for Financing State and Local Government, CES Pm 1281, Iowa State University, Nov 1986.

be somewhat uniformly distributed across the groups. This means that it is not only the small districts that are impacted by declining enrollments, nor is it only the large districts that are experiencing enrollment increases. About the same percentage of large and small districts are faced with severely declining enrollment projections. In addition, about the same percentage of large and small districts are faced with increasing projected enrollments for the 1990-91 school year.

A qualification of these results are in order because the Iowa school districts groups with higher per pupil costs may not be totally due to differences in efficiencies. No adjustments were made for differences in input prices, diversity of courses offered or transportation expenditures, etc. Therefore, the higher cost per pupil may be attributed to a combination of three factors: inefficiencies of large or small size, differences in local market costs of educational inputs, differences in pupil sparsity and geographical size, and differences in desired levels of program offerings, teacher training, and teacher experience.

It's clear from the numerous studies that have been done that size economies do exist in the provision of primary and secondary education. However, the particular quantitative results should be viewed with caution. Since every state has its own characteristics (population, population density, existing structures, etc.) the empirical results of one state may not apply to another.

One additional note of caution is in order. While size economies are likely to exist, the benefits of achieving them may or may not be greater than the transition costs of consolidation

in all cases. In some districts, the economies of size in school operations may be more than offset by increases in transportation costs, severance costs, and new facility costs.

CONCLUSIONS AND IMPLICATIONS

This review of research has presented a brief overview of the literature concerning the effect of enrollment decline on costs of education and the existence of size economies in education. The multitude of studies reviewed generally indicate that economies of size do exist and declining enrollment does increase the per pupil costs of education and does alter the management practices of schools. However, there is wide disagreement as to where the minimum threshold is for size economies depending upon the sparsity of the districts analyzed.

It is important to note that while a literature review can provide valuable insights into the general impacts of enrollment declines, such studies cannot be substituted for careful up-to-date local research. Specific estimates of the impacts are only found by local research because states differ greatly in their characteristics and policies and numbers for one state are not that useful in other states.

Finally, there is no general agreement on a standard definition or a universally accepted measure of quality of education. We possess the tools to measure differences in diversity of programs, depth of specialization, staffing ratios by school size and other attributes by magnitude of declining enrollment. However, statistical significance does not necessarily mean political significance. Therefore, a political value judgment must be made as to whether size economies and

effects of declining enrollments are important enough for incorporating adjustments into state school aid distributions.

And, if so, should the goal of such adjustments in the aid formula favor adjustment incentives to achieve economies of size or favor preservation of the status quo in light of declining enrollment? Significant trade-offs between these two strategies appear to exist.

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APPENDIX A: Discussion Outline: School District Sharing

Prepared by Dr. Mark A. Edelman for meetings of 10 school districts at Sheffield, Iowa, May 13, 1987 and Burt, Iowa, March 10, 1988.

SITUATION: Prompted by a desire to maintain and improve the quality of education in the area and to capitalize on community trends and opportunities, a group of concerned citizens began to discuss the implications of the various ways for their schools to come together in some form of strategic alliance. The nature of the undertaking, its importance, and the need for objectivity led this group to request that the Extension Service sponsor an educational meeting to provide an opportunity to learn more about the current situation and the options available.

Specifically, we were asked to do four things as outside resource persons who have no direct vested interest in the outcome of the issue:

1. Describe the nature and scope of your policy problem.
2. Outline the alternative solutions.
3. Discuss the probable consequences.
4. Leave the decision-making up to those in the audience.

THE PROBLEM: HOW SHOULD THE SCHOOLS BE ORGANIZED TO PROVIDE THE KIND OF EDUCATIONAL OPPORTUNITY DESIRED FOR YOUR CHILDREN?

QUESTION A: WHAT KIND OF EDUCATIONAL OPPORTUNITY DO YOU WANT FOR YOUR HIGH SCHOOL KIDS?

- OPTIONS:**
1. **Narrow Choice in Courses?**
40 course units (+ or - 5)
 2. **Moderate Choice in Courses?**
50 course units (+ or - 5)
 3. **Wide Choice in Courses?**
60 course units (- 5 or plus more)

QUESTION B: HOW LARGE OF A HIGH SCHOOL PUPIL POOL DOES IT TAKE FOR OPERATING EFFICIENCY UNDER EACH EDUCATIONAL OPPORTUNITY?

- OPTIONS:**
1. **Narrow Choice only requires 80 - 120 pupils.**
 2. **Moderate Choice requires 150 - 250 pupils.**
 3. **Wide Choice requires 300 pupils or more.**

QUESTION C. WHAT KIND OF EDUCATIONAL OPPORTUNITY DO YOU WANT FOR YOUR ELEMENTARY SCHOOL CHILDREN?

- OPTIONS:**
1. **One teacher for all subjects and all eight grades?**
 2. **One teacher for each grade, with the possibility for multi-grade specialization only?**
 3. **Two teachers for each grade, with some teachers specializing in part of the subjects.**

QUESTION D. HOW LARGE OF AN ELEMENTARY PUPIL POOL DOES IT TAKE FOR OPERATING EFFICIENCY UNDER EACH EDUCATIONAL OPPORTUNITY?

- OPTIONS:**
1. **A one-room school requires 25 to 30 kids.**
 2. **One teacher for each grade requires 200 to 240 kids.**
 3. **Two teachers for each grade requires 400 to 480.**

QUESTION E. ARE YOU WILLING TO HAVE YOUR HIGH SCHOOL KIDS TRAVEL FURTHER THAN YOUR ELEMENTARY SCHOOL CHILDREN?

For a given geographic area, there are normally half as many kids of high school age as there are elementary school age. So, for those who want one teacher in each elementary grade and moderate to wide subject choice in high school, the geographic area covered by the high school would need to be two to three times as large as the elementary school. In other words, if there are 900 pupils or more in the district, you can have two to three elementary schools for every high school and still be efficient.

QUESTION F. WHAT ARE THE SCHOOL ORGANIZATION OPTIONS?

- OPTIONS?**
1. Each district keeps an independent high school and may or may not consolidate administrative costs.
 2. Two high schools join together and one stays independent or goes with an outside high school.
 3. Three high schools join together.

QUESTION G. WHAT ARE THE PROBABLE CONSEQUENCES OF EACH OPTION?

- OPTIONS:**
1. Independent high schools each with about 100 pupils (about 300 total per district) would likely continue to provide narrow choice in courses.
 2. Two high schools joining together would create a pool of 200 pupils (about 600 total per area K-12) and would likely provide moderate subject choice.
 3. Three high schools joining together would create a pool of 300 pupils (900 in total area K-12) and would likely provide wide choice in courses.

- There are financial incentives built into the state school aid formula for sharing and school restructuring.
- There may be some potential long-term savings from improving economies of scale in the schools. However, the savings may not be immediately realized due to restructuring costs, changes in program structure and changes in personnel costs.
- In the short run, it maybe more difficult to get agreement among three or more separate entities compared to two. In the long run, given the geographical situation the odds for continued economic and educational stability of your rural coalition of schools is diminished if two join the partnership.

QUESTION H. WHAT ARE THE PRINCIPLES IN SHAPING A PARTNERSHIP?

- * Create an opportunity for improved quality of service, cost savings and/or operating efficiency.
- * Establish a healthy financial foundation for the future.
- * Ensure that each participant is better off in the partnership than outside of it.
- * Ensure fair treatment of all participants going in.
- * Provide an equitable sharing of future control and benefits.
- * Allow flexibility and room for innovation.

Table 1. TYPICAL COURSES ADDED AS HIGH SCHOOL SIZE INCREASES.
 (Actual Courses Added Vary Widely Depending On Local Priorities)

Curriculum Courses	Four-Year High School Size		
	100 Pupils	200 Pupils	300 Pupils
ENGLISH:			
English I	x		
English II	x		
English III	x		
Compos/Writing	x		
Speech/Debate		x	
Am Lit/Journalism			x
MATH:			
Algebra	x		
Adv Algebra	x		
Gen Math	x		
Adv Gen Math	x		
Geometry	x		
Computer	x		
Sr Math Topics	x		
Trig/Calc/Pre-Algebra			x
SCIENCE:			
Biology I	x		
Chemistry I	x		
Gen Science	x		
Physical Science	x		
Physics	x		
Chem 2/Biol 2/Bot/Zool		x	
SOCIAL STUDIES:			
Geography	x		
US Government	x		
Hist/Cultures	x		
US History	x		
Sociology/Psych	x		
BUSINESS:			
Acct/bkkg	x		
Gen Business	x		
Office Procedures	x		
Typing I	x		
Typing II		x	
Economics			x
Shorthand/Sec Sci			x
INDUSTRIAL TECH:			
Gen Shop I	x		
Gen Shop II	x		
Woodwkg I	x		
Drafting/Design		x	
Metals/Woodwkg II		x	
Auto/Mechanics			x

Curriculum Courses	Four-Year High School Size		
	100 Pupils	200 Pupils	300 Pupils

HOME ECONOMICS:

Gen Home Ec	x		
Gen Home Ec	x		
Family Rel	x		
Clothing/Textiles		x	
Foods/Nutrition			x

AGRICULTURE:

Agriculture I	x		
Agriculture II	x		
Animal Sci		x	
Plant Sci		x	
Fm Bus Mgt			x
Ag Mechanics			x

HEALTH OCCUPATIONS:

FINE ARTS:

Art I	x		
Art II	x		
Vocal Music	x		
Band	x		
Crafts		x	
Drawing/Painting			x

FOREIGN LANGUAGE:

Spanish I	x		
Spanish II	x		
Spanish III/IV		x	
French I/II			x

PHYSICAL EDUCATION:

Phys Ed	x		
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<u>TOTAL COURSES:</u>	40	50	60
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SOURCE: Edelman, Mark A. "Discussion Outline: School District Sharing." Approximations are based on analysis of data from the Iowa Department of Education, 1987.

APPENDIX B: BRIEF SUMMARIES OF THE RESULTS OF SELECTED STUDIES

1. Debertin, David L. "Impact of Decreases in School Enrollments on Educational Costs."

Debertin studied enrollment decline in Indiana between the school years 1972-'73 and 1976-'77. His study was done with district level data on total expenditures and various expenditure categories. He found:

- Total per pupil expenditure, instructional expenditure per pupil, per pupil expenditures on plant operation and maintenance were all inversely related to change in enrollment level.
- Pupil/teacher ratio was directly related to change in enrollment level.
- Assessed valuation per pupil was inversely related to change in enrollment level.

2. Cavin, Edward S., Richard J. Murnane and Randall S. Brown. "School District Responses to Enrollment Changes: The Direction of Change Matters!"

Cavin, Murnane and Brown looked at school district data for Michigan for all years between 1971 to 1981.

- They found that enrollment change was inversely related to per pupil expenditure
- The effects on expenditures are more acute in the short run.
- They also found that per pupil staffing levels changed in the same manner as expenditures per pupil; they increased significantly in the first year or two and never fully retrenched to pre-decline levels in the long run.
- In addition, they found that the effects of enrollment decline was especially acute in small districts since it is relatively harder for them to adjust.

3. Odden, Allan and Phillip Vincent. "The Fiscal Impacts of Declining Enrollments in Four States--Michigan, Missouri, South Dakota and Washington."

Odden and Vincent used district level data to analyze the effects of declining enrollment in the above mentioned states.

They found:

- Declining enrollments are distributed unevenly across districts within a state.
- Declining enrollments have affected the smallest and largest districts the most severely.
- Declining enrollment districts, in general, have above average property wealth per pupil and receive above average state aid per pupil. There are wide variations in the wealth and tax rates of districts with declining enrollment.
- Declining enrollment school districts have higher than average per pupil total, instructional, operation and maintenance of plant, and fixed expenditures. They also have lower pupil/teacher ratios.

4. Wilken, William H. and John J. Callahan. "Declining Enrollment: The Cloud and Its Silver Lining."

Wilken and Callahan present some results they calculated for Iowa in the early 1970's. They found:

- Declining enrollment hit the smallest and largest districts the most.
- Declining enrollment is worse in the northwestern part of the state.
- School districts with the highest decline are generally the ones with the highest expenditures per pupil.
- Districts with declining enrollments can finance increased expenditures easier than other districts.

5. Fox, William F. "Reviewing Economies of Size in Education."

Fox does an extensive review of the literature concerning economies of size in education before 1981. He provides a detailed discussion of the theoretical and empirical techniques used in economies of size studies. In addition, he reports the general results from a number of studies. The previous studies have found:

- Studies that looked at size economies for schools generally found that size economies existed. They usually find u-shaped average cost curves with minimums of 100 to 1800 pupils.

--Studies that looked district level data found minimum average costs occurring at levels of 100 to 50000 pupils. These studies were heavily dependent on the nature of the school districts. Lower thresholds were associated with the more sparsity presences in the districts analyzed.

--Generally, when larger than district level aggregations of data were used little if any size economies existed.

6. Riew, John. "Scale Economies, Capacity Utilization and School Costs: A Comparative Analysis of Secondary and Elementary Schools."

The purpose of Riew's study is to illustrate the differences in size economies between elementary and secondary schools. He fits u-shaped cost curves to data from Maryland schools from 1978-'79. He finds:

--The number of pupils associated with the minimum average cost is different for elementary and secondary schools. In particular, the minimum occurs at over 1000 students for secondary schools and at over 700 for elementary schools.



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